A-120 AMPLIFIER (McINTOSH)
TESTS, ADJUSTMENTS AND REQUIREMENTS

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1. GENERAL

1.01 This section describes the tests, adjustments and requirements associated with the McIntosh A-120 Amplifier. It includes routine maintenance and trouble investigation tests.

1.02 This section is reissued to simplify testing procedures. Since a general revision has been made, arrows ordinarily used to indicate changes have been omitted.

1.03 Section 024-121-300 lists the initial and routine tests, as well as information on the frequency of routine maintenance tests, on the McIntosh A-120 Amplifier.

1.04 A list of parts for the A-120 Amplifier is included in Section 024-121-100.

1.05 *Test Equipment:* The tests throughout this section require the use of the following test equipment:

1 — KS-14510 Volt-Ohm-Milliammeter or Weston 779A Analyzer

1 — KS-15560 or KS-15750 Tube Tester

1 — 21A Transmission Measuring Set

1 — Daven 600^{w}: 30^{w} 20 db Attenuator, Type T-154 (required only if 30^{w} input is used)

1 — Output Pad as described in Paragraph 2.08

3 — W3U or W3AE Shielded Cords or equivalent

1 — 600-Ohm Resistor, 106A or equivalent

1.06 Tests should be made in the order listed. Cord shields should be connected to the plug sleeves at the TMS end.

2. TESTS AND ADJUSTMENTS

Primary Power Voltage Measurement

2.01 The purpose of this test is to determine which terminals on the terminal strip in the amplifier are to be connected to the ac supply.

2.02 *Apparatus:*

KS-14510 Volt-Ohm-Milliammeter or Weston 779A Analyzer

2.03 *Procedure:*

(1) Adjust the voltmeter for an ac voltage reading of over 100 volts.

(2) Measure the supply voltage at the fuse box or other convenient point between the fuse box and the amplifier.

Required Strapping: The correct terminals for the connection of primary power are as follows:

AC VOLTAGE SUPPLY	TERMINALS
110-120	COM and 117V
120-130	COM and 125V

The "neutral" conductor should be connected to either the 117V or 125V terminal.

Caution: In making these measurements care should be taken to avoid contact with live terminals. Disconnect supply voltage before changing terminal connections.

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Electron Tube Tests

2.04 These tests will check the tubes for correct operation in the amplifier.

2.05 *Apparatus:*

1 — KS-15560 or KS-15750 Tube Tester

2.06 *Procedure:*

(1) Test each tube in accordance with the information given in Section 100-635-101.

(2) Discard any tubes that fail to meet the requirements.

Caution: When the amplifier is operating, the tubes will be too hot to handle safely. Use gloves or tube pulling tool for removing a tube.

Gain and Gain-Frequency Tests

2.07 Gain tests on the McIntosh A-120 Amplifier require care due to the amount of gain which will be encountered and also to the fact that this type of amplifier is capable of greater power output than those usually encountered in the telephone plant. The use of shielded connecting cords is specified. This should aid materially in avoiding errors due to stray coupling between input and output circuits when measuring gain. In all cases an attenuator should be employed between the source of testing power and the amplifier. A pad between the output of the amplifier and the transmission measuring set is also specified in order that the power handling capacity of the latter will not be exceeded. The case of the transmission measuring equipment should be grounded to the amplifier chassis when these tests are made. If the amplifier is not installed in an equipment rack, the chassis should be grounded during these tests; a third conductor is provided in the power cord for this purpose.

2.08 Amplifier gain is measured between 600-ohm impedances with the amplifier operating at a level of +40 dbm at the 600-ohm output terminals. Fig. 1 shows a suggested arrangement of the output pad referred to in Paragraph 2.07. The pad must be capable of dissipating 10 watts of power. R1 is a 294-ohm 5-watt noninductive resistor and R2 is a 12-ohm 1-watt noninductive resistor. If available 18HY (294-ohm) and 18HN (12-ohm) resistors may be used. The nominal loss of this pad is 40 db, the actual value will depend upon the accuracy of the resistors used. The actual pad loss should be determined by test since it must be known for the computations of the amplifier gain. Amplifier gain may also be measured using the 1-ohm output circuit; the indicated level at this point is 27.8 db below the level at the 600-ohm terminals. This assumes that the 600-ohm measuring set is directly connected to the 1-ohm output; no impedance matching transformer is required.

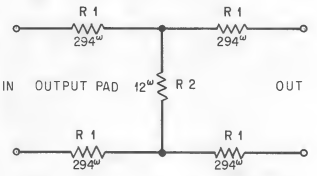


Fig. 1 – Suggested Output Pad Arrangement

2.09 *Apparatus:*

The following equipment is required for making these tests:

1 — Daven 600Ω:30Ω 20 db Attenuator, Type T-154

1 — Output Pad as described in Paragraph 2.08

1 — 21A Transmission Measuring Set

3 — W3U or W3AE Shielded Cords

If a 21A TMS is not available an equivalent assembly consisting of an oscillator, attenuator and transmission measuring set may be used. Where such alternate arrangements are used, the case of each piece of apparatus should be grounded.

2.10 *Procedure:*

Set up one of the testing arrangements indicated in Fig. 2. The oscillator output should be adjusted for −40 dbm. The amplifier gain controls should be turned fully clockwise (maximum amplifier gain) and the input selector switch set on the "600Ω" position. The gain of

the amplifier is indicated by the algebraic sum of the input level below 0 dbm, output pad loss and the dial and meter readings on the measuring set. The levels shown in Fig. 2 are representative of those which will be found during this test.

Requirement: The amplifier gains should be within the limits given in Table 1.

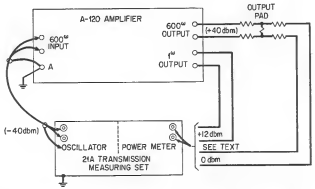


Fig. 2 — A-120 Amplifier — Gain and Gain-Frequency Testing Arrangement

2.11 Make a 1000-cycle attenuation test by observing that the gain reduces as the gain controls are turned from maximum to minimum. The A-120 Amplifier is equipped with two controls. One provides 4.5 db of attenuation in 0.5 db steps and the other 40 db of attenuation in 5 db steps. In order to keep transmission measuring set reading nearly constant, compensate for the change in gain control attenuation by a corresponding decrease of attenuation in the 5A Attenuator.

Requirement: The 5 db steps should be within 1.0 db of the indicated attenuation and the 0.5 db steps should be within 0.1 db of the indicated attenuation.

2.12 The following test may be omitted if the 30-ohm input circuit is not normally used when the amplifier is in service. Connect the Daven 600Ω:30Ω 20 db Attenuator between the 5A Attenuator and the amplifier input terminal. Place the input selector switch S1 in the "30Ω" position. Other connections should remain as indicated in Paragraphs 2.08, 2.09 and 2.10.

Requirement: The 1000-cycle gain (G_b) should be not less than 20 db greater than G_a, the gain measured using the 600-ohm input per Paragraph 2.10.

Maximum Output Test

2.13 The amplifier should be tested to determine that it can supply its maximum rated power using the test arrangement described in Paragraph 2.10 and with the output pad connected to the 600-ohm terminals, increase the input level until the amplifier is supplying its maximum rated power to the pad. The time involved in making this test should be kept to a minimum in order to avoid overheating the resistors used in the output pad.

Requirement: The amplifier should deliver a maximum output of not less than +45 dbm at 1000 cycles. If the transmission measuring set is connected to the 1-ohm output circuit the indicated level will be +17 dbm.

TABLE 1

FREQUENCY IN CYCLES	MAXIMUM GAIN REQUIREMENT 600-OHM OUTPUT TERMINALS MINIMUM	600-OHM OUTPUT TERMINALS MAXIMUM	1-OHM OUTPUT TERMINALS MINIMUM	1-OHM OUTPUT TERMINALS MAXIMUM
20	G_a −0.7	G_a +0.7	G_a −0.7	G_a +0.7
50	G_a −0.5	G_a +0.5	G_a −0.5	G_a +0.5
100	G_a −0.2	G_a +0.2	G_a −0.2	G_a +0.2
500	G_a −0.2	G_a +0.2	G_a −0.2	G_a +0.2
1,000 (G_a)	79.5 db ± 1.5		51.5 db ± 1.5	
5,000	G_a −0.2	G_a +0.2	G_a −0.2	G_a +0.2
10,000	G_a −0.2	G_a +0.2	G_a −0.2	G_a +0.2
15,000	G_a −0.5	G_a +0.5	G_a −0.5	G_a +0.5
20,000	G_a −0.7	G_a +0.7	G_a −0.7	G_a +0.7

Noise Test

2.14 This test is made to verify that the ratio of maximum rated single-frequency signal to steady noise is at least 75 db.

2.15 ***Apparatus:***

1 — 21A Transmission Measuring Set

1 — 600-Ohm Resistor, 106A or equivalent

2.16 ***Procedure:***

(1) Terminate the input of the amplifier under test with the 600-ohm resistor.

(2) Set up the testing arrangement shown in Fig. 3, using the transmission measuring set; shielded connecting cords may be used but are not required.

(3) Adjust amplifier controls for maximum gain and the input selector switch to the "600Ω" position.

(4) Adjust the "hum balance" potentiometer for minimum reading on the transmission measuring set.

Requirement: The noise should not exceed −30 dbm.

(5) Short-circuit the 30-ohm input terminals.

(6) Set the input selector switch to the "30Ω" position.

Requirement: The noise should not exceed −15 dbm.

Preliminary Trouble Locating Tests

2.17 When the amplifier fails to meet test requirements and the cause is not due to defective tubes, the amplifier should be checked (with the power disconnected) for loose connections or broken wires, or other visible evidence of malfunction. Fig. 4, Page 10, shows a schematic diagram of the A-120 Amplifier. If the amplifier can be operated without harm (such as by arcing or overheating) then there is one simple test which may help to locate the trouble. With the amplifier set up as described in Paragraph 2.10 and with the amplifier gain adjusted so as to supply +10 dbm (10 milliwatts) to the transmission measuring set, bridge an 8-ohm resistor (such as Type 18 FW) across the 8-ohm output circuit (terminals 14 and 16). If this change from a light load condition to a more than full load condition causes the transmission measuring set reading to decrease more than 1 db, a trouble condition is indicated within the feed-back loop involving V3, V4, V5, V6, V7, V8 and V9. If the trouble is indicated by excess amplifier gain the feed-back circuit should be checked for continuity.

Operating Voltage Measurements

2.18 If the tests mentioned above fail to reveal the trouble, it will be necessary to check the operating voltages in the amplifier. The values of voltages on the various elements of the electron tubes may be measured at the tube sockets on the underside of the chassis. The voltages should be measured between the point indicated and the B negative lead, or to the chassis. Table 2 lists the voltages to be found at the various circuit points when the amplifier is operating normally and without input signal applied. Fig. 5 shows the pin numbering arrangements for electron tube sockets as viewed from the wiring side.

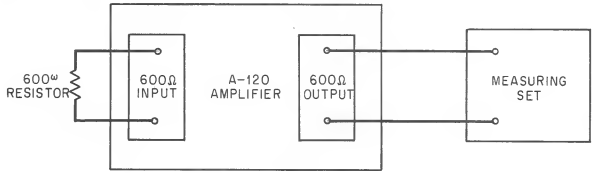


Fig. 3 — Noise Measuring Arrangement

Table 2

STAGE	TYPE	PIN 1	2	3	4	5	6	7	8	9
V 1	12AX7	215	0	2.3	H	H	140	0	1.35	H
V 2	12AX7	280	140	145	H	H	280	140	145	H
V 3	12AX7	110	0	1.1	H	H	265	−1.8	0	H
V 4	12AU7	270	108	118	H	H	270	**	118	H
V 5	12BH7	225	0	10.6	H	H	225	0	10.6	H
V 6	12AX7	295	−28	−28	H	H	295	−28	−28	H
V 7	6BX7	270	400	295	270	400	295	**H	**H	
V 8	350B	0	H	400	295	−28	Vac.	H	0.75	
V 9	350B	0	H	400	295	−28	Vac.	H	0.75	
V 10	422A	Vac.	425	Vac.	**	Vac.	**	Vac.	425	

(H) Indicates tube heater connection.
(Vac.) Indicates no connection to tube elements.
** Do not attempt to read dc voltage on this pin.

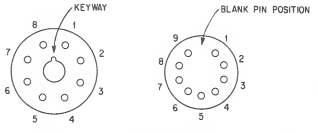


Fig. 5 – Tube Socket Pin Numbering System

2.19 ***Apparatus:***

KS-14510 Volt-Ohm-Milliammeter or Weston 779A Analyzer

2.20 ***Procedure:***

(1) Switch on the amplifier and wait for at least one minute.

(2) Verify that the line voltage and power connections are proper (Paragraph 2.03).

(3) Obtain voltage readings, beginning at the output of the power rectifier tube, and working back through the circuit to the elements of the other tubes until an indication of the trouble location is obtained.

Caution: In making these tests, care should be taken to avoid contact with live terminals.

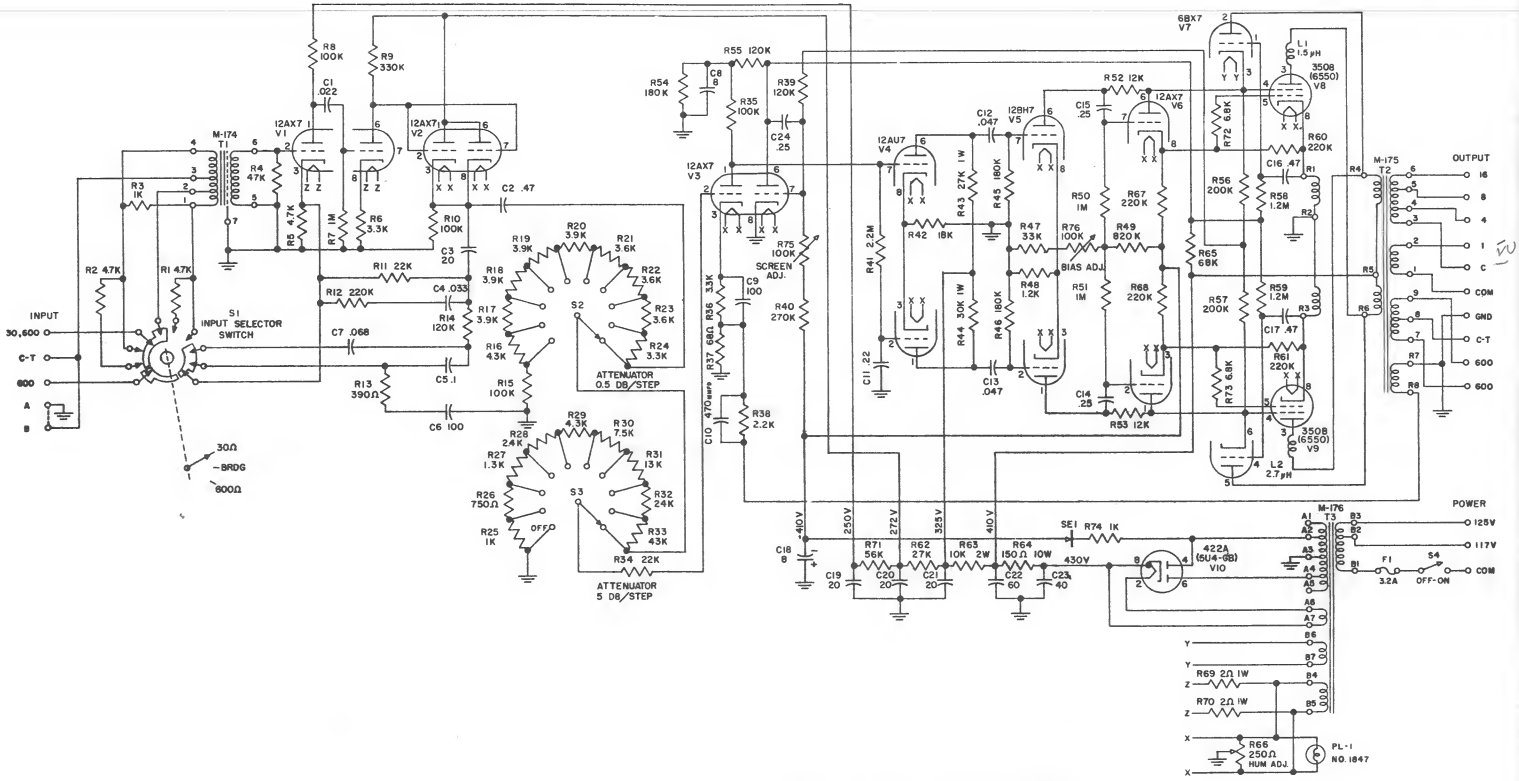
Distortion

2.21 Measurement of the several kinds of amplifier distortion involves the use of equipment and techniques which are not usually a part of test room operation. The presence of distortion can be detected by connecting an oscilloscope in parallel with the oscillator and the measuring set (alternately) when the gain-frequency tests are made. If the wave form is changed in any respect (other than amplitude) distortion is present. If such distortion is not found to be due to faulty electron tubes the amplifier circuit components must be investigated for faulty operation. After the source of the trouble has been found, remedial measures can be taken. The component parts of the amplifier are described in Section 024-121-100.

Electrolytic Capacitor Testing and Replacement

2.22 It may be necessary to attempt to re-form the film in the electrolytic capacitors in the A-120 Amplifier if the latter has not been in use for several months. This may be done by following the method described in Section 032-110-701.

2.23 If the hum level of the amplifier is high after an attempt has been made to re-form the capacitor film, the capacitors should be tested as described in Section 032-110-701, and replaced where the need is indicated.



NOTE: ADJUST R-75 FOR 295 VOLTS MEASURED FROM V8 OR V9 PIN 4 (SCREEN GRID) TO GROUND.

ADJUST R-76 FOR -29 VOLTS MEASURED FROM V8 OR V9 PIN 5 (CONTROL GRID) TO GROUND.

Fig. 4 – Schematic Diagram McIntosh Amplifier Model A-120